Information Science & Technology Student/Postdoc Seminar

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"Deep Generative Models of Primate Visual Cortex"

Wednesday, July 27, 2011
3:00 - 4:00 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: Building cortex-like visual representations is a long-standing goal of computational vision. Following the architecture of visual cortex but emphasizing feedback processes as generators of semantically informed, locally self-consistent image predictions, I describe a deep generative network model here. The approach is a generalization of generative models with sparse constraint, from primary visual cortex (V1) to a hierarchy of (deep hidden) cortical layers, corresponding to visual areas V2, V4, and IT in the primate ventral pathway. The Bayesian framework is utilized to address visual inference in the hierarchal structure, where each cortical area is an expert for inferring certain aspects of the visual scene, constrained by the bottom-up data from the feedforward connections, lateral data with temporal contexts, and the top-down data from feedback connections. An optimized continuation method is adopted to iteratively search a converged solution with high efficiency.

This generative network is applied to natural images, and develops internal presentation that matches the neuroscience findings in primate visual cortex. The primary visual cortex, V1, presented an over-complete set of Gabor-like filters, while higher layers in the ventral pathway contains more complex features than V1. A degree of visual invariance regarding objects are emergent via local pooling of the hierarchal presentations. Using the benchmark object identification data sets like Caltech 101, our new systems-level computational model is able to generate hierarchal internal representation better than the SIFT-based approach and convolutional networks, etc.

Biography: Zhengping Ji received his B.S. degree in electrical engineering from Sichuan University, and his Ph.D. degree in computer science from Michigan State University. He is now a research associate at T-5, Theoretical Division, Los Alamos National Laboratory. Before that, he was a postdoctoral fellow at Center for the Neural Basis of Cognition, Carnegie Mellon University. His research interests include computer vision, neural computation and mobile robotics. He is a member of International Neural Network Society and a member of the IEEE.

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